**SA WG2 Meeting #143eS2-210**

**Feb 24th – March 9th, 2021 ; Elbonia (revision of S2-210)**

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| *CR-Form-v12.1* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **23.288** | **CR** |  | **rev** | **-** | **Current version:** | **16.7.0** |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network |  | Core Network | **X** |

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| ***Title:*** | DCCF and ADRF Architectural Changes to Increasing efficiency of data collection | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Nokia, Nokia Shanghai Bell | | | | | | | | | |
| ***Source to TSG:*** | S2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | eNA\_Ph2 | | | | |  | ***Date:*** | | | 2021-01-26 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-17 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-15 (Release 15) Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | Introduce DCCF, MAF and ADRF for Data Collection Coordination and Data Storage | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | 1. Section 4.1 and 4.2 - Introduce DCCF, MAF and ADRF 2. Section 5A – Introduce DCCF and options for data deliver 3. Section 6.2 – Initial Update to procedures for Data Collection | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Data Collection and storage is not updated to reflect conclusions in TR23.700-91 | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 4.1, 4.2, (NEW) 5A, (NEW) 5A.1, (NEW) 5A.2, (NEW) 5A.3, (NEW) 5A.3.1, (NEW) 5A.3.2, (NEW) 5A.4, (NEW) 5A.5, 6.2.1 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **x** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  | **x** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

*FIRST CHANGE*

# 4 Reference Architecture for Data Analytics

## 4.1 General

The NWDAF (Network Data Analytics Function) is part of the architecture specified in TS 23.501 [2] and uses the mechanisms and interfaces specified for 5GC in TS 23.501 [2] and OAM services (see clause 6.2.3.1).

The NWDAF interacts with different entities for different purposes:

- Data collection based on subscription to events provided by AMF, SMF, PCF, UDM, AF (directly or via NEF), and OAM;

- [Optionally] Analytics and Data collection using the DCCF;

- Retrieval of information from data repositories (e.g. UDR via UDM for subscriber-related information);

- [Optionally] Storage and retrieval of information from ADRF;

- [Optionally] Analytics and Data collection from Message Adaptor Function;

- Retrieval of information about NFs (e.g. from NRF for NF-related information);

- On demand provision of analytics to consumers, as specified in clause 6.

A single instance or multiple instances of NWDAF may be deployed in a PLMN. If multiple NWDAF instances are deployed, the architecture supports deploying the NWDAF as a central NF, as a collection of distributed NFs, or as a combination of both.

NOTE 1: When multiple NWDAFs exist, not all of them need to be able to provide the same type of analytics results, i.e., some of them can be specialized in providing certain types of analytics. An Analytics ID information element is used to identify the type of supported analytics that NWDAF can generate.

NOTE 2: NWDAF instance(s) can be collocated with a 5GS NF.

## 4.2 Non-roaming architecture

As depicted in Figure 4.2-1, the 5G System architecture allows NWDAF to collect data from any 5GC NF. The NWDAF belongs to the same PLMN as the 5GC NF that provides the data.



Figure 4.2-1: Data Collection architecture from any 5GC NF

The Nnf interface is defined for the NWDAF to request subscription to data delivery for a particular context, to cancel subscription to data delivery and to request a specific report of data for a particular context.

The 5G System architecture allows NWDAF to retrieve the management data from OAM by invoking OAM services.

The 5G System architecture allows NWDAF to collect data from any 5GC NF or OAM using a DCCF standalone function, as specified in clause 5A.

  
Figure 4.2-1a: Data Collection architecture using Data Collection Coordination

As depicted in figure 4.2-1a, the Ndccf interface is defined for the NWDAF to support request(s) for data delivery from a DCCF, to cancel subscription to data delivery, and to request a specific report of data. If the data is not already being collected, the DCCF requests the data from the Data Source using Nnf services. The DCCF may collect the data and deliver it to the NWDAF or the DCCF may rely on a messaging framework to collect data from the NF and deliver it to the NWDAF.

As depicted in Figure 4.2-2, the 5G System architecture allows any 5GC NF to request network analytics information from NWDAF. The NWDAF belongs to the same PLMN as the 5GC NF that consumes the analytics information.



Figure 4.2-2: Network Data Analytics Exposure architecture

The Nnwdaf interface is defined for 5GC NFs, to request subscription to network analytics delivery for a particular context, to cancel subscription to network analytics delivery and to request a specific report of network analytics for a particular context.

NOTE: The 5G System architecture also allows other consumers such as OAM and CEF (Charging Enablement Function) to request network analytics information from NWDAF.

The 5G System architecture allows any 5GC NF to request network analytics information from an NWDAF using a DCCF standalone function.



Figure 4.2-3: Network Data Analytics Exposure architecture using Data Collection Coordination

## As depicted in figure 4.2-3, the Ndccf interface is defined for any NF to support subscription request(s) to network analytics, to cancel subscription for network analytics, and to request a specific report of network analytics. If the analytics is not already being collected, the DCCF requests the analytics from the NWDAF using Nnwdaf services. The DCCF may collect the analytics and deliver it to the NF, or the DCCF may rely on a messaging framework to collect analytics and deliver it to the NF.

*NEXT CHANGE (ALL NEW TEXT)*

# 5A Data Collection Coordination and Delivery Functional Description

## 5A.1 General

Data Collection Coordination and Delivery coordinates the collection and distribution of data requested by NF consumers. It prevents data sources from having to service multiple subscriptions for the same data and send multiple notifications containing the same information due to uncoordinated requests from data consumers.

In this Release of the specification Data Collection Coordination and Delivery is applicable to:

* NWDAFs that request data from a Data Source (e.g., for use in computing analytics).
* NF consumers that request analytics from an NWDAF Data Source.
* NF consumers that request data from an ADRF Data Source.
* ADRFs that receive data from an NF Data Source.

NOTE: Data may be collected directly from an AF or be collected from an AF via an NEF.

## 5A.2 Data Collection Coordination

Data Collection Coordination is supported by a Data Collection Coordination Function (DCCF). The Data Consumer may use an NRF to perform NF discovery and selection to find a DCCF that can coordinate data collection (DCCF discovery principles are defined in clause 6.3.xx, TS 23.501 [2]). Data Consumers send requests for data to the DCCF rather than directly to the NF Data Source. For the Data Consumer and each notification endpoint in a data request, the Data Consumer may specify Formatting and Processing Instructions that determine how the data is to be provided. Upon receiving a request from a Data Consumer, the selected DCCF determines the NF instance that can be a Data Source if the Data Source is not indicated in the Data Consumer’s request. The DCCF may also select an ADRF if the data is to be stored in an ADRF and an ADRF endpoint is not indicated in the Data Consumer’s request. To retrieve data for a specific UE, the NRF, UDM or BSF can provide the DCCF with the identity of the Data Source using the services indicated in table 5A.2-1.

Table 5A.2-1: NF Services consumed by DCCF to determine which NF instances are serving a UE

| Type of NF instance (serving the UE) to determine | NF to be contacted by DCCF | Service | Reference in TS 23.502 [3] |
| --- | --- | --- | --- |
| UDM | NRF | Nnrf\_NFDiscovery | 5.2.7.3 |
| AMF | UDM | Nudm\_UECM | 5.2.3.2 |
| SMF | UDM | Nudm\_UECM | 5.2.3.2 |
| BSF | NRF | Nnrf\_NFDiscovery | 5.2.7.3 |
| PCF | BSF | Nbsf\_Management | 5.2.13.2 |
| NEF | NRF | Nnrf\_NFDiscovery | 5.2.7.3 |
| NWDAF | UDF | Nudm\_UECM | 5.2.3.2 |

The DCCF keeps track of the data actively being collected from the Data Sources it is coordinating. It may do so by maintaining a record of the active prior requests it sends to each Data Source. If a NWDAF or ADRF Consumer subscribes for data directly with a Data Source, the NWDAF or ADRF may register the data collection with the DCCF. The DCCF may then coordinate collection of data from the NWDAF or ADRF.

When the DCCF receives a request for data, it determines the status of data collection from the Data Source. If parameters in a request for data from a Data Consumer match those in a prior request or in a data collection registration, the DCCF may determine that the requested data is already being collected from a Data Source or that a prior subscription to a Data Source may be modified to in addition satisfy the requirements of the new data request from a Data Consumer. This status is used in clause 5A.3 to deliver data to the Data Consumer and notification endpoints.

For persisting event exposure subscriptions for long-lived data collection the DCCF may subscribe to the UDM to receive event notifications even if a Data Source that serves a UE changes.

The DCCF may subscribe to the NRF to receive event notifications if a Data Source changes (e.g. because of a NF life-cycle event).

## NOTE: A DCCF may support multiple Data Sources, Data Consumers, and Message Frameworks. However, to avoid duplicate data collection, each Data Source NF or Set of Data Source NF should be associated with only one DCCF instance or dCCF Set

## 5A.3 Data Delivery

Data is provided to Consumers or notification endpoints according to the Delivery Option configured on the DCCF. Delivery Options are:

1. Delivery via DCCF: Consumers or Notification Endpoints receive the data from the DCCF.

2. Delivery via Messaging Framework: Consumers or Notification Endpoints receive the data from the Messaging Framework via the services offered by the MAF.

### 5A.3.1 Data Delivery via the DCCF



Figure 5A.3.1-1: Data Delivery via DCCF

Data Delivery via DCCF is shown in figure 5A.3.1-1. Each Event Notification received from a Data Source NF is sent to the DCCF which propagates it to all Data Consumers / Notification Endpoints specified by the Data Consumers or determined by the DCCF. Each Data Consumer may specify in its request to the DCCF multiple notification endpoints, which may include the requesting Data Consumer, an ADRF or other NFs. The DCCF may also select an ADRF or other notification endpoint based on configuration. The DCCF supports formatting and processing for each Consumer / notification endpoint so notifications comply with the data requests received from each Consumer NF.

Upon the DCCF determining the status of data collection for a data request (see clause 5A.2):

- If the requested data is not already being collected from a Data Source, the DCCF sends a new subscription/request towards the Data Source with the notification target specified as the DCCF.

- If the requested data is partially covered by existing subscriptions with the Data Source, the DCCF sends the Data Source a request to modify the subscription.

When notifications are received by the DCCF, they are processed according the Formatting and Processing Instructions for each Consumer and notification endpoint. The DCCF subsequently sends notifications to Consumers and notification endpoints via a Ndccf\_DataManagement service.

### 5A.3.2 Data Delivery via a Messaging Framework



Figure 5A.3.2-1: Data Delivery via a Messaging Framework

Data Delivery via a Messaging Framework is shown in figure 5A.3.2-1. The Messaging Framework formats and processes data received from the Data Source NF and sends notifications to all Data Consumers and Notification Endpoints specified by Data Consumers or determined by the DCCF. Each Data Consumer may specify in its request to the DCCF multiple notification endpoints, which may include the requesting Data Consumer, an ADRF or other NFs. The DCCF may also select an ADRF or other notification endpoint based on configuration. While the Messaging Framework is not standardized by 3GPP, a Messaging Adaptor NF (MAF) offers 3GPP defined services that allow the 5GS to interact with the Messaging Framework. Internally, the Messaging Framework may for example support the pub-sub pattern, where received data are published to the messaging framework and requests from 3GPP Consumers result in messaging framework specific subscriptions. Alternatively, the Messaging Framework may support other protocols outside of the scope of 3GPP.

The Messaging Adaptor NF offers services that enable the 5GS to interact with the messaging framework:

* 3GPP Consumer Adaptor (3CA) Data Management Service: Nmaf\_3caDataManagement Service delivers data to each Data Consumer or notification endpoint after formatting and processing of data received by the messaging framework.
* 3GPP DCCF Adaptor (3DA) Data Management Service: Nmaf\_3daDataManagement Service enables the DCCF to convey to the messaging framework information about the data the messaging framework will receive from a Data Source, formatting and processing instructions and the Data Consumer and notification endpoints.

Upon the DCCF determining the status of data collection for a data request (see clause 5A.2):

- If the requested data is not currently being collected from a Data Source, the DCCF sends a new subscription/request towards the Data Source with the notification target specified as the messaging framework.

- If the requested data is partially covered by existing subscriptions with the Data Source, the DCCF sends a request to the Data Source to modify one or more subscriptions to accommodate both the previous requests for data and the new request for data.

NOTE: The internal logic of DCCF, e.g. how it decides on what modifications to do, is not specified.

- The DCCF uses the Nmaf\_3daData Management service to convey information so:

1. the Messaging Framework can recognize data that are received from a Data Source.

2. the MAF can obtain data received by the Messaging Framework, process and format the data according to processing and formatting instructions for each Consumer / notification endpoint and send notifications or responses to the Data Consumers.

When data are received by the Messaging Framework (e.g., because of an event notification) they are processed according the Formatting and Processing Instructions for each Consumer / notification endpoint before notifications are sent to the Data Consumer or Notification Endpoints. Notifications sent via the Nmaf\_3caDataManagement service have the same content as those sent via a Ndccf\_DataManagement service for Data Delivery via the DCCF.

## 5A.4 Data Formatting and Processing

Formatting and Processing instructions may be provided in requests by Data Consumers via the Ndccf\_DataManagement service. When using the Messaging Framework, the DCCF sends the instructions to the Messaging Framework via the Nmaf\_3daData\_Management Service so the MAF may process and format the data before sending notifications to the Data Consumers / notification endpoints. When using Data Delivery via the DCCF, the DCCF performs processing and formatting before sending notifications.

Formatting determines when a notification is sent to the Consumer. Formatting Instructions comprise:

- Notification Event clubbing: Buffering and sending of several notifications in one message.

- Notification Time Window (example: notifications are buffered and sent between 2 and 3 AM).

- Cross event reference-based notification: When a subscribing NF is subscribing to multiple events (e.g.: event X and event Y) the notification for an Event-X is buffered and reported only when the Event-Y occurs.

- Consumer triggered Notification: Notifications are buffered until the consumer requests delivery using Ndccf\_DataManagement or Nmaf\_3caDataManagement Service.

- Exact time-based Notification: Notifications are sent to the Consumer at an exact time, irrespective of whether the event occurs (example: every 30 min).

- Increasing time window based notification: Notifications are sent to the Consumer at an increasing periodicity (example: the first notification is sent immediately, subsequent received notifications are sent after 5 min, then after 10 min, then after 15 min, etc.).

Processing instructions allow summarizing of notifications to reduce the volume of data reported to the Data Consumer. The processing may result in joining multiple notifications into a single combined notification, or the combining of information from multiple notifications into a common report.

Editor’s Note: Formatting and Processing should be aligned with normative text that supports TR23.700-91 Conclusions in Clause 8.11.3 “Signalling reduction via Event Exposure service enhancement”.

## 5A.5 Historical Data Handling

ADRF as a Data Source:

When the DCCF receives a request for data that includes a period in the past and ADRF is deployed, the DCCF may request data from ADRF as the Data Source. The data obtained from the ADRF is delivered to Consumers / Notification Endpoints according to a configured Delivery Option. The DCCF may determine that requested data is available in an ADRF by querying the ADRF.

ADRF as a Data Recipient:

An ADRF may be a Consumer NF that initiates requests to the DCCF for data, the ADRF may be specified as a notification endpoint by another Consumer NF that wants to have data it requests archived, or the DCCF may be configured to archive certain data in a ADRF (e.g. all data from an AMF instance).

If the ADRF instance is not specified in a request for data by a Consumer NF, the DCCF may select the ADRF instance based on provisioned information or information received from the NRF.

Data is delivered to the ADRF according to a configured Delivery Option (via DCCF or Messaging Framework).

*NEXT CHANGE*

# 6 Procedures to Support Network Data Analytics

## 6.0 General

This clause specifies procedures to support network data analytics function.

Clause 6.1 and clause 6.2 specify generic procedures which apply to all type of analytics, while clause 6.3 and onwards specify procedures specific to some type of analytics.

## 6.1 Procedures for analytics exposure

## 6.2 Procedures for Data Collection

### 6.2.1 General

The Data Collection feature permits NWDAF to retrieve data from various sources (e.g. NF such as AMF, SMF, PCF, and AF; OAM), as a basis of the computation of network analytics.

All available data encompass:

- OAM global NF data,

- Data available in NFs, e.g. behaviour data related to individual UEs or UE groups (e.g. UE reachability), and pre-computed metrics covering UE populations (e.g. number of UEs present in a geographical area), per spatial and temporal dimensions (e.g. per region for a period of time),

- NF data available in the 5GC (e.g. NRF),

- Data available in AF.

The NWDAF shall use at least one of the following services:

- the Generic management services as defined in TS 28.532 [6], the Performance Management services as defined in TS 28.550 [7] or the Fault Supervision services as defined in TS 28.545 [9], offered by OAM in order to collect OAM global NF data.

- the Exposure services offered by NFs in order to retrieve data and other non-OAM pre-computed metrics available in the NFs.

- Other NF services in order to collect NF data (e.g. NRF).

- DCCF data management service to retrieve data using DCCF.

The NWDAF shall obtain the proper information to perform data collection for a UE, a group of UEs or any UE:

- For an Analytics ID, NWDAF is configured with the corresponding NF Type(s) and/or event ID(s) and/or OAM measurement types.

- NWDAF shall determine which NF instance(s) of the relevant NF type(s) are serving the UE, the group of UEs or any UE, taking into account the S-NSSAI(s) and area of interest as defined in clause 7.1.3, TS 23.501 [2].

- NWDAF invokes Nnf\_EventExposure\_Subscribe services to collect data from the determined NF instance(s), and/or triggers the procedure in clause 6.2.3.2 to subscribe to OAM services to collect the OAM measurement.

The NWDAF performs data collection from an AF directly as defined in clause 6.2.2.2 or via NEF as defined in clause 6.2.2.3.

The NWDAF shall be able to discover the events supported by a NF.

Data collection procedures enables the NWDAF to efficiently obtain the appropriate data with the appropriate granularity.

When a request or subscription for statistics or predictions is received, the NWDAF may not possess the necessary data to perform the service, including:

- Data on the monitoring period in the past, which is necessary for the provision of statistics and predictions matching the Analytics target period.

- Data on longer monitoring periods in the past, which is necessary for model training.

Therefore, in order to optimize the service quality, the NWDAF may undertake the following actions:

- The NWDAF may return a probability assertion as stated in clause 6.1.3 expressing the confidence in the prediction produced. Prediction may be returned with zero confidence as described below. This confidence is likely to grow in the case of subscriptions.

- The value of the confidence depends on the level or urgency expressed by the parameter "preferred level of accuracy of the analytics" as listed in clause 6.1.3, the parameter "time when analytics information is needed" as listed in clause 6.1.3, and the availability of data. If no sufficient data is collected to provide an estimation for the requested level of accuracy before the time deadline, the service shall return a zero confidence. Otherwise, the NWDAF may wait until enough data is collected before providing a response or a first notification.

- In order to be prepared for future requests on analytics from NFs/OAM, the NWDAF, upon operator configuration, may collect data on its own initiative, e.g. on samples of UEs, and retain the data collected in the data storage.

NOTE 1: The NWDAF can send an error response to the analytics consumer to indicate that statistics are unavailable if the NWDAF was not prepared for future requests and did not collect data on its own initiative.

The volume and maximum duration of data storage is also subject to operator configuration.

The NWDAF may decide to reduce the amount of data collected to reduce signalling load, by either prioritizing requests received from analytics consumers, or reducing the extent (e.g. duration, scope) of data collection, or modifying the sampling ratios.

The NWDAF may skip data collection phase when the NWDAF already has enough information to provide requested analytics.

The data which NWDAF may collect is listed for each analytics in input data clause and is decided by the NWDAF.

NOTE 2: NWDAF can skip data collection phase for some specific input data per the requested analytics e.g. when some of the data is already available at NWDAF for the requested analytics, or when NWDAF considers that some of the data is not needed at all to provide the requested analytics as per the analytics consumer request (e.g. based on preferred level of accuracy or based on the time when analytics are needed).

*END OF CHANGES*